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AUTHOR Jones, Marshall G.
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ABSTRACT

This paper reports the findings of an ongoing study of engagement in computer-based learning environments. The purpose of the study was to look at what engages people in computer games and to see how those patterns of engagement might be used within computer-based learning environments. The age of participants ranged from four to adulthood. Participants, engaged in both open systems and closed systems, were studied to ferret out strategies of learner engagement. Results are discussed in the following areas: problem definition; visual quality, including passive and active aesthetics; types of interactions; and point of view. Findings indicate that problem identification, physical representation, and interaction styles can be manipulated to help foster engagement of learners in computer-based learning environments. (MES)

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By:

Marshall G. Jones

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What Can We Learn From Computer Games: Strategies For Learner Involvement

Marshall G. Jones
The University of Memphis

This paper reports the findings of an ongoing study of engagement in computer-based learning environments. Participants engaged in both open systems and closed systems were studied to ferret out strategies of learner engagement. Findings indicate that problem identification, physical representation, and interaction styles can be manipulated to help foster engagement of learners in computer-based learning environments.

Introduction

The computer and all of its digital manifestations are causing us to rethink the way we do everything from producing to disseminating media (Negroponte, 1996). The term Virtual Reality (VR) is meant to imply that the reality exists outside of the physical world. For a number of people, computer generated reality isn't virtual at all. Computer generated environments are real: they just happen to be on the computer. This can best be seen in computer and video games, where people may spend their time, to the point of distraction, playing these games. It matters not that the environment has no counterpart in the physical world. What matters is the quality of the interactions, the problems, and representations of them. People not only play in these environments, but they live within these environments as well (Herz, 1997). For better or worse, digitally rendered environments can be as, at times more, engaging than reality. While this is true for computer-based gaming environments, this is not true, necessarily, for computer-based learning environments (Jones, 1997). The impetus for this study was not that educational software should look like, or in any way mirror computer games. Educational software that tries to copy gaming patterns tends to be fatuous. Rather the question was are there engagement strategies that are used in games that can be applied to educational software. Again, the desire was to look at strategies and not techniques. The purpose of this study was to look at what engages people in computer games, and to see how those patterns of engagement might be used within computer-based learning environments. The findings presented here represent nearly two years of studying various populations of people as they play games and work in computer based learning environments. The study has progressed to include both open and closed environments (Jones & Farquhar, 1997). The ages of participants ranged from age 4 to adulthood. The number of study participants to date is 17. However it should be noted that each individual may have been engaged and studied in multiple environments. Current research is looking at on-line formal and informal learning communities.

Procedures

Engagement here is defined as "...nexus of intrinsic knowledge and or interest and external stimuli that promote the initial interest in, and continued use of a computer-based learning environment" (Jones, 1998, pg. 205). Engagement was studied in three ways: (1) direct observations of people as they worked in an environment; (2) interviews with people after they had been engaged in the environment; (3) analysis of written discourse through e-mail, journals, and other artifacts. Many of the interviews were conducted at a distance, consequently not all participants were observed working in the environment.

Findings

Findings of the study are presented through a combination of narratives and static graphics. Because many of the findings discussed here involve intricate interactions, it may be difficult to represent them on a printed page.

Problem Definition

Engagement was found to be enhanced due to the nature of the problem itself. Problems that are accepted by a user can promote engagement, and consequently the user maintains interest in the problem. Interest in the problem, or having a well defined question, provides the learner with intrinsic motivation to be working within the environment.

Learners who are intrinsically, or self, motivated have found that something as generic as a multi-media encyclopedia can be engaging. The motivation comes from within, and the environment itself need not be engaging beyond its ability to present the content in a factual manner. Learners have reported being engaged in generic environments such as data bases. For example, one participant was relocating to another city, and was doing research on their new city. While not formal didactic instruction, the activity was certainly about learning.

> Ned and his family were relocating to Tampa, FL from Chicago, IL. Among the many things he had to do was to find a house. Ned is a 60 year old college professor. While he has access to the WWW, he has never used it beyond very simple browsing. When shown a web site listing real estate for sale in Tampa, his interest and expertise increased as his use increased. The problem itself provided him with a compelling reason to be on line. He reported increased interest in the web, and demonstrated greater command of the online world. "It is funny. I started out looking for a house, but what I found was a collection of information that was available to me. I soon found out that I could manage one of retirement accounts on line. I never thought that I would ever do this."

The point is not a dramatic conversion to the WWW. The point is that Ned found a problem that engaged him, thus keeping him actively engaged in the environment. Finding other problems that were equally engaging has kept him using the web. Ned has not, at this reporting, become an expert HTML programmer and opened an e-commerce operation. It is unlikely that he will. He will, however, continue to use the WWW to solve certain types of problems thus pointing further that problem identification by the user can be an important means of engaging the user. Learners who can generate their own problems often demonstrate greater manifestations of engagement in open systems. In closed systems, the problem is often generated for the learner.

If the learner is not intrinsically motivated, or interested in the problem the environment provides, then the environment may need to offer greater extrinsic motivational features to keep the learner interested. This was noted in non-golfers playing computer-based golf games. People who were not golf players in the physical world were often engaged in golf games. There are many reasons for this. It is less time consuming to play golf on a computer. It is less expensive; less stressful, and for many people, less embarrassing. One of the key reasons stated by several participants was that the manner in which the game was represented gave them the impetus to play it.

> "I don't really have the time to play golf. I have always thought it to be kind of an elitist activity. And I really don't think I want to play golf 'live.' But I did think that the golf game was kind of cool. It didn't feel much like golf, but more like just, you know, playing any other kind of game. ...the music in the background was a little weird, but the graphics were very good. I liked having the control over the game. Choosing the clubs, having to click just right to get the right swing...."

While this person did not find golf that interesting, the environment about golf was interesting. And while problems which are fatuous or uninteresting do not promote engagement regardless of the quality of the visuals or other features of the product, the quality of the presentation appears to have an impact on whether or not somebody will try the problem. This leads into the next area, visual quality.

Visual quality

The gaming community appreciates not only good problems, but well rendered problems as well. In order to contribute to the engagement of the user, graphics and other multi-media assets must not only be well rendered, but must also contribute to the gestalt of the environment. Including graphics as "window dressings" is not appreciated, and can impact engagement levels negatively. As one player in a computer game reported:

> "I don't know why they included those video clips on top of the heads of the still graphics. I suppose it is because they could. But honestly I started to think of some old Saturday Night Live gag, and I couldn't take it seriously."

In looking at the use of multi-media assets in varying environments, it has become useful to look at them through the lens of Csikszentmihalyi's (1990) Flow Theory. I propose that there are two types of aesthetic elements, active and passive aesthetics (Jones & Surry, In Press).

Passive Aesthetics

Passive aesthetics may be aligned with Csikszentmihalyi's (1990) definition of pleasure. Pleasure is defined here as being passive in nature, and not requiring active participation by an individual. Passive aesthetics are elements in the program that may provide visual or auditory texture to the program. For example, background images in a program can do a number of things. A background can provide depth and texture to your program. It can provide learners with a visually pleasing image that is not overwhelming to look at, and which may provide the developer with an interesting canvas on which to "paint." Additionally, background music can help set the tone for an environment as well. For example, the driving beat in *Doom II* provides a feeling of intensity, while the nature sounds in *Golf* give one the feeling of being out of doors. Background images may help the user maintain the feeling of belief in the environment. Simply having an attractive background is not enough. The background must sell the user on the underlying theme (I hate to say metaphor) of the program.

In educational software, passive aesthetics are often attended to. It is not difficult to locate background images that can add visual depth and texture to the program. The washed out image residing behind control bars is quite familiar to us. It is seen in both educational CD-ROMS (closed systems) and web-based environments (open systems). What is more difficult is finding tools that are integrated into the visual system of the program which perform the function intended. We refer to these elements are active aesthetics.

Active Aesthetics

It is easier to locate active aesthetics in commercial computer games than in educational software. It is also difficult to represent them on the printed page. Active aesthetics are tools within the environment which perform particular functions within the environment. For example, in *PGA Tour Golf III* your goal is to manage all the data available to play the hole well. The user has access to wind direction and speed, the type of terrain, and suggested club to be used. This is represented in Figure 2. These pieces of the program all work together to weave a seamless fabric of integration of images, content, and control. It works to provide the user with an environment that works to promote the engagement of the user.

Figure 2. Tools Working Together In An Environment

Within educational programs, active aesthetics serve as tools to help people interact with the software. At its most basic level, we are talking about stimulus and response activities here, and stimulus response activities are often pejoratively associated with behavioral psychology and basic drill and practice activities. But it is important to note that what involves people in a computer based environment is *being involved*. Users should be clicking, dragging, calculating, comparing, and generally interacting with the information in the program itself. Simply being presented with the information is not enough for many learners. Working with the information takes on paramount importance. It follows that if we are to develop interactive materials then we need to develop methods to allow users to interact. Computer games provide two types of interaction to examine.

Types of Interactions

Interaction in computer games can be classified in two ways: Twitch and Strategy games. Strategy games are ones in which the user must employ higher order thinking skills and problem solving skills to continue playing and win the game. Twitch games are games in which the user must react quickly to circumstances, usually by killing someone, to continue playing and win the game (see Figure 3). *SimCity* and *War Craft II* are immediate examples of strategy games, while games like *Doom* and its various representations are consummate twitch games. The advantage to a twitch game is that the movement is quick, and the feedback immediate. This works to keep the user actively engaged. However the level of this engagement is often superficial. It does not typically engage one beyond the most basic level of seeing, pointing, and clicking. Strategy games require the user to look at the larger problem, and plan a strategy to solve the problem. In some games, such as *SimCity*, the results of your decisions are not immediately recognized. You must have a fair amount of internal motivation to stay with the game to realize the fruits of your labor. While twitch games offer immediate results of your work, strategy games appear to offer a greater feeling of accomplishment and satisfaction. One participant who was playing *War Craft* praised the combination of "twitch and strategy." While they ultimately liked working on complex problems in an environment, they also appreciated the sheer visceral rush of immediate feedback.

Consequently, when designing learning environments, it should be the goal to include "fast action" along with a more unifying problem to be solved. One simple method of doing this is to include twitch type mini-games within a larger strategy game. *Monty Python's Quest for the Holy Grail* does this, as does *11th Hour*. And while it is not seamless, and can appear a bit crude, it does at least provide a faster element to the environment than many strategy games typically afford. Educational games such as *Math Blaster* offer the twitch with some elements of thinking, but these types of games are simple drill and practice activities in disguise. They are good for practicing certain skill sets, but do little to help develop higher order thinking skills. One possibility would be to use math skills to solve certain problems that relate to the larger problem. The difference is that the individual skills then become tools to solving the larger problems, which is ultimately the goal of education in the first place.

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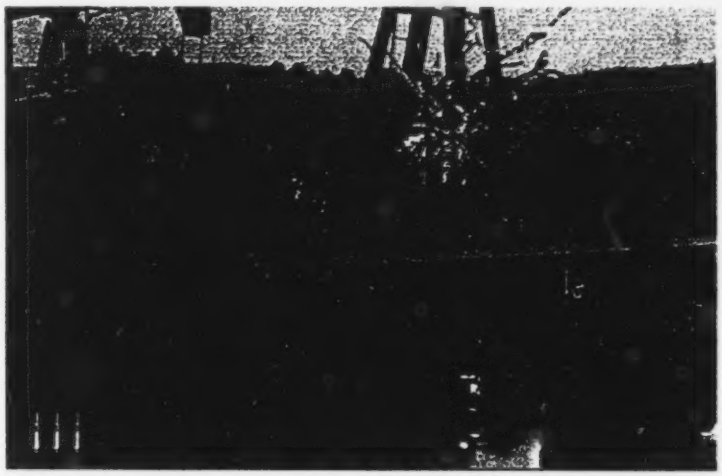
Point of View

Engagement can be done through how the user sees or controls the screen. Referred to as Point of View (POV), the reference point that one takes can influence how one is engaged. Looking at the screen down the barrel of a gun (see Figure 3) engages you in the world as the participant. You never see the entity being controlled: it is assumed you are the entity and you are controlling yourself.

Figure 3. A Single Point Of View: Looking Down Barrel Of A Gun In A Twitch Game



Other games, such as Golf, (see Figure 2) have you see the person you are controlling. There is a distinct visual difference between the two. In one, you are looking at the world as a participant. In the other, you are looking at the world as a disconnected observer/controller. People engaged in these environments do not report a difference between which environment is likely to be more engaging initially. Nor does there appear to be any difference in a person's ability or likely hood to accept that the entity being controlled is the user in either environment. The key difference appears to be that over time many people become bored with a single point of view. Therefore it may follow that multiple perspectives in the environment can help keep the user engaged in the environment. Working from a single POV can promote tunnel vision, and may not support continued use over time. This supports something that has been known in the gaming community for a number of year: A level is still just a level. The quality of the level, the problems one encounters, how those problems are manifested, will determine how well it is received by the user. Many games provide the user with multiple points of view. One may be from the perspective of your character or agent, the other may be a map view to help you navigate a maze, as in *Doom II*, the other may be a birds eye view, as in many golf games, to let you see the entire hole at one time. Multiple views provide multiple perspectives, or multiple representations of the phenomenon. Multiple perspective appear to provide a greater feeling of engagement on the part of the user. In *Kyoto: The Cosmology of Old Japan*, the user has the opportunity to determine physically how they are represented (See Figure 4). There appears to be some support for allowing this kind of control over the POV.

> In Kyoto: The Cosmology of Old Japan *the user has the option of selecting the features of their character in the program. One can select gender, body type, and facial features. Among participants, this was found to be a unique feature. Only one person represented themselves as a different gender, but many people played the game several times from different perspectives. Sue, an 18 year old college freshman said: "What was weird was that I felt like different things happened because of the shape of my face. I don't know if they did, or if my awareness of it changed. ...I definitely knew that I was different in the game."*

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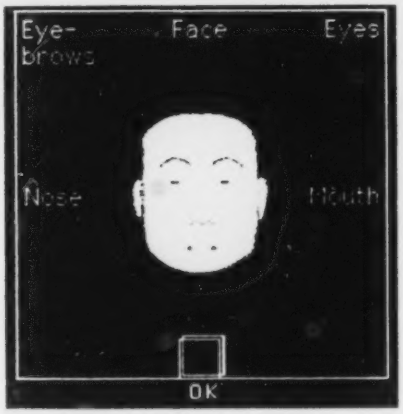
Figure 4. Changing The Face Of Your Character In An Environment



Future Research

In terms of problem identification for users, this appears to provide greater support for student centered learning environments. As we move from more traditional closed learning environments, such as educational CD-ROMS to more open environments as can be found on the WWW, the notion of letting learners generate the problem becomes more critical. The one area that those of us working in educational software need to consider more carefully is representation of our materials. It is becoming increasingly important to produce materials that can challenge a sophisticated group of users. As always, more research is needed to fully understand exactly how and why people are engaged in computer-based learning environments.

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